

Great Lakes Water Levels and Coastal Impacts

November 2020

Brandon Krumwiede

Physical Scientist / Great Lakes Regional Geospatial Coordinator

NOAA Office for Coastal Management

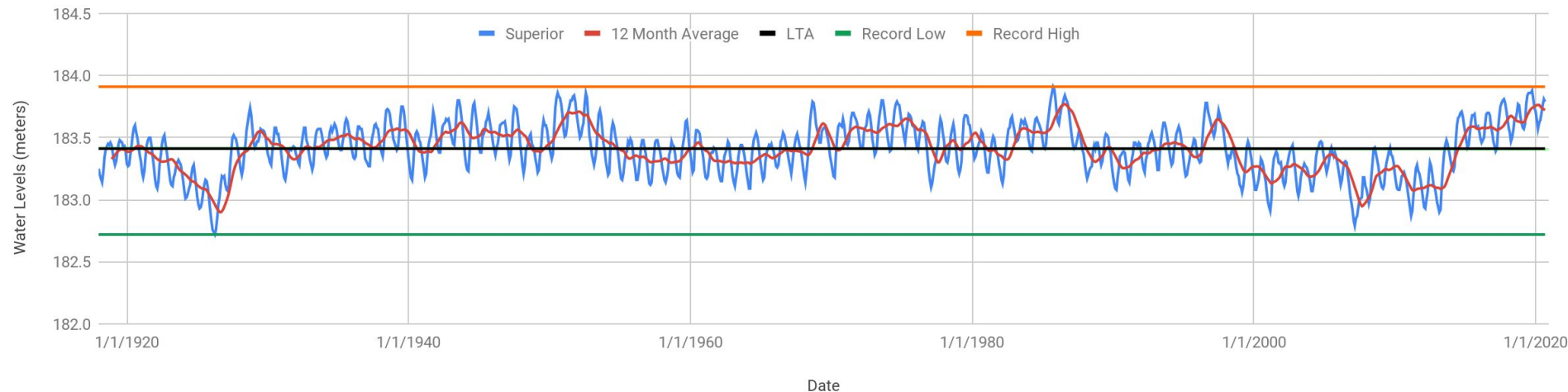
The Coastal Challenge

- Shorelines are naturally dynamic and complex due to the interface between land, water, and air
- Coastal management refers to actions taken to keep residents safe, the economy sound, and natural resources functioning
- Work towards protecting coastal communities



Complexity of Water Levels: Superior

Lake Superior Monthly Water Levels (USACE/NOAA)



Minimum Water Level: 182.72 meters / 599.47 feet (April 1926)

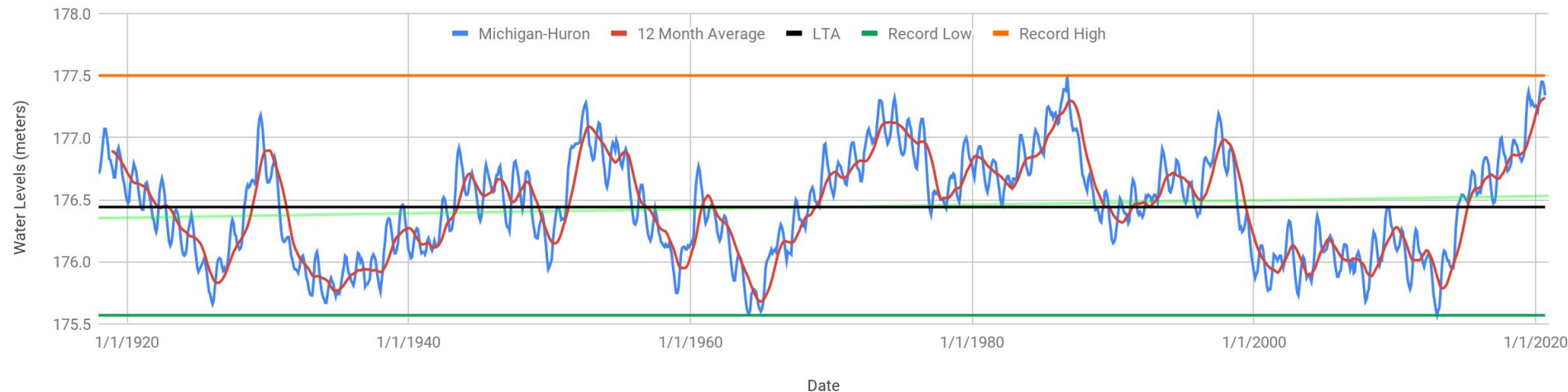
Maximum Water Level: 183.91 meters / 603.37 feet (October 1985)

183.88 meters / 603.28 feet (October 2019)

Difference: 1.19 meters / 3.9 feet

Complexity of Water Levels: Michigan-Huron

Lake Michigan-Huron Monthly Water Levels (USACE/NOAA)



Minimum Water Level: 175.57 meters / 576.02 feet (January 2013)

Maximum Water Level: 177.5 meters / 582.35 feet (October 1986)

Difference: 1.93 meters / 6.33 feet

177.45 meters / 582.19 feet (June and July 2020)

Complexity of Water Levels: St. Clair

Lake St. Clair Monthly Water Levels (USACE/NOAA)



Minimum Water Level: 173.88 meters / 570.47 feet (January 1936)

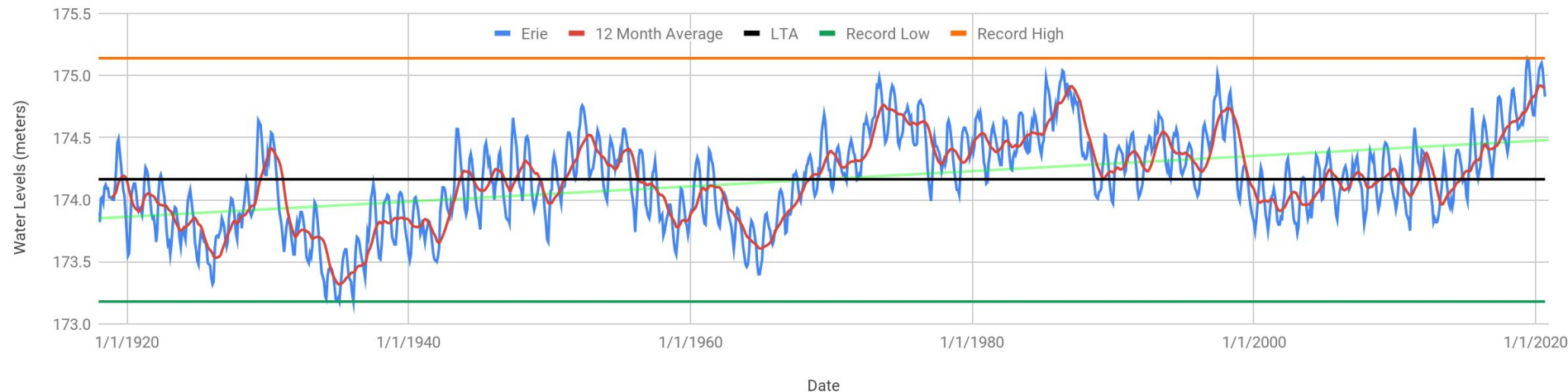
Maximum Water Level: 176.04 meters / 577.55 feet (July 2019)

176.03 meters / 577.52 feet (July 2020)

Difference: 2.16 meters / 7.08 feet

Complexity of Water Levels: Erie

Lake Erie Monthly Water Levels (USACE/NOAA)



Minimum Water Level: 173.18 meters / 568.17 feet (February 1935)

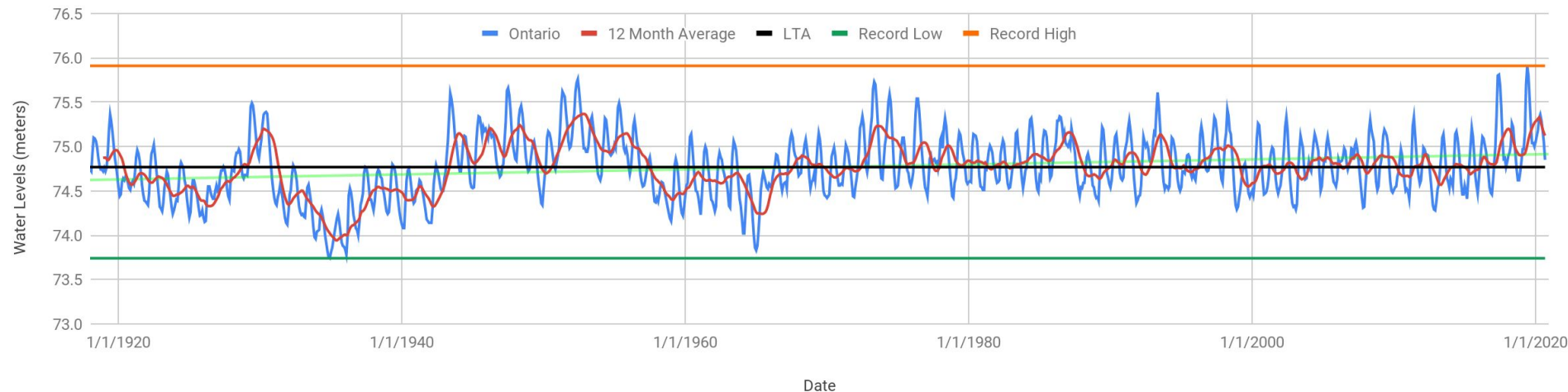
Maximum Water Level: 175.14 meters / 574.6 feet (June 2019)

175.08 meters / 574.4 feet (May 2020)

Difference: 1.96 meters / 6.43 feet

Complexity of Water Levels: Ontario

Lake Ontario Monthly Water Levels (USACE/NOAA)



Minimum Water Level: 73.74 meters / 241.92 feet (December 1934)

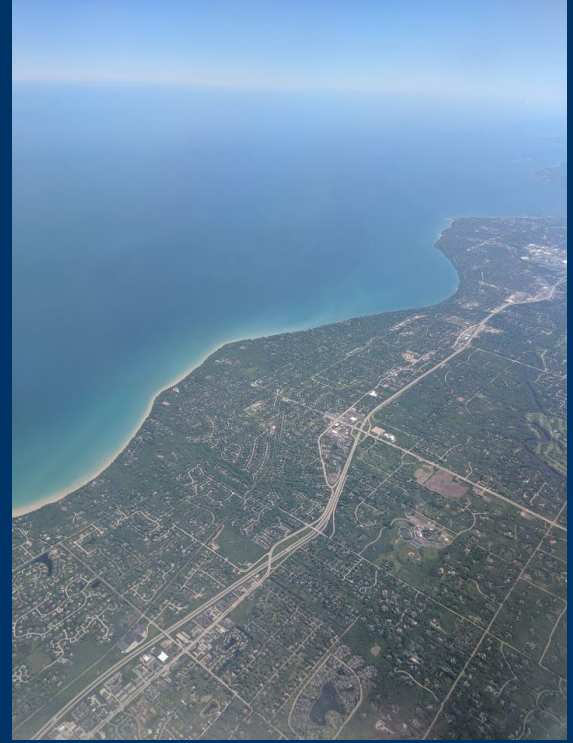
Maximum Water Level: 75.91 meters / 249.04 feet (June 1919)

75.36 meters / 247.24 feet (May 2020)

Difference: 2.17 meters / 7.12 feet

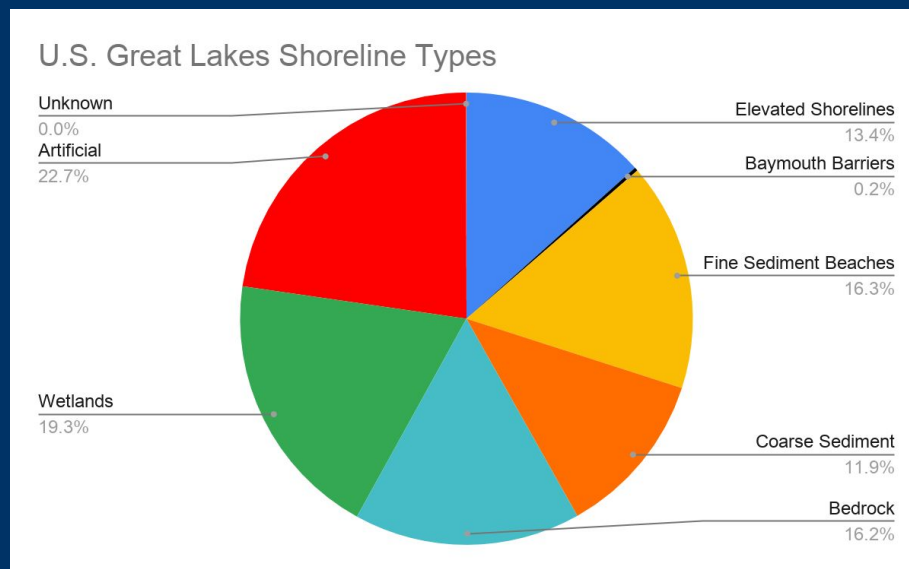
Physical Impacts

- Coastal Flooding
- Shoreline Erosion/Deposition
- Increased sediment transport in the littoral zone
- Alterations to stream and river mouths
- Loss of coastal terrestrial and wetland habitat
- Increased impacts when storms move through



U.S. Great Lakes Shoreline

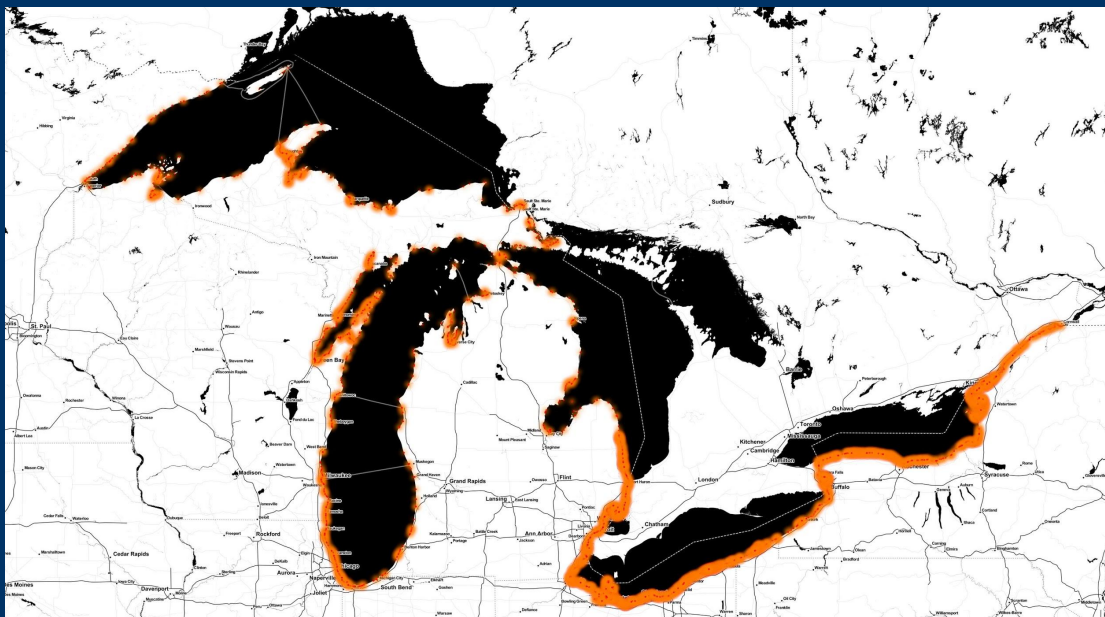
Shoreline Type	Length (mi)
Elevated Shorelines (Bluffs, Banks, Low Plains)	959.55
Baymouth Barriers	17.79
Fine Sediment Beaches	1172.40
Coarse Sediment Beaches	852.74
Bedrock	1161.50
Wetlands	1381.42
Artificial	1626.08
Unknown	3.07



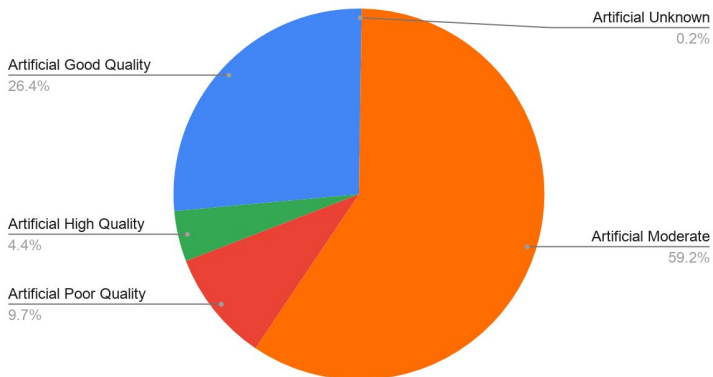
Source: Summarized from 2019 US Great Lakes Hardened Shorelines Classification Dataset

U.S. Great Lakes Shoreline: Artificial/Hardened

Over 1/5 of the U.S. Great Lakes shoreline is classed as artificial or hardened by coastal infrastructure



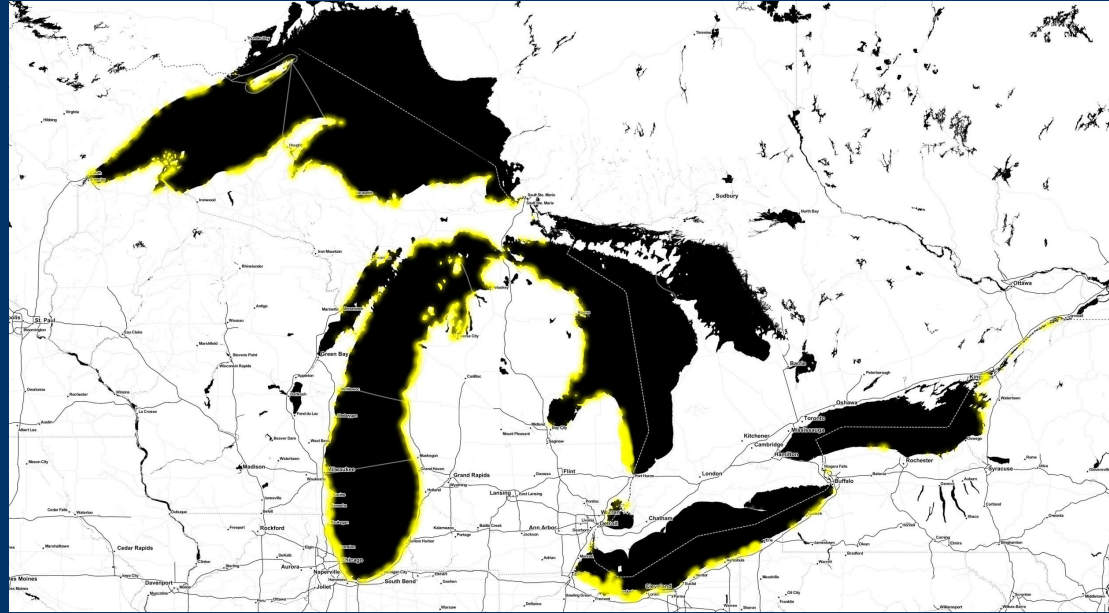
U.S. Great Lakes Artificial Shoreline Condition



Source: 2019 US Great Lakes Hardened Shorelines Classification Dataset

U.S. Great Lakes Shoreline: Beaches

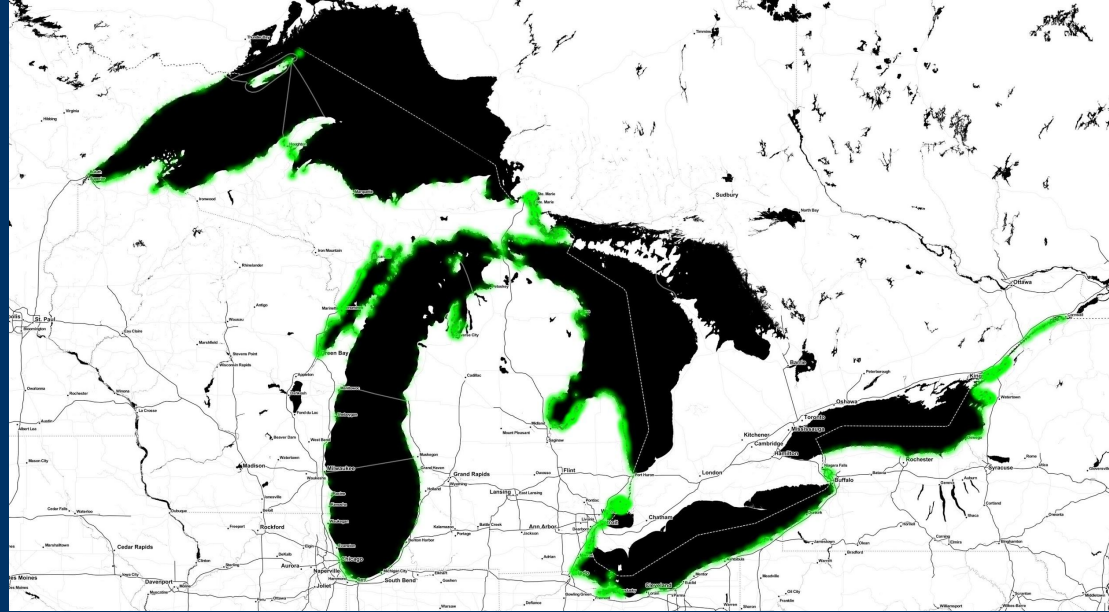
- Over 16% of the U.S. Great Lakes shoreline is classed as fine sediment beaches
- High concentration in Lake Michigan
- Highly dynamic and susceptible to changes in water levels, storms and longshore (littoral) drift



Source: 2019 US Great Lakes Hardened Shorelines Classification Dataset

U.S. Great Lakes Shoreline: Wetlands

- About 1/5 of the U.S. Great Lakes shorelines are classed as coastal and river mouth wetlands
- These wetland extents are dynamic in response to changes in water levels



Source: 2019 US Great Lakes Hardened Shorelines Classification Dataset

Illinois Beach State Park

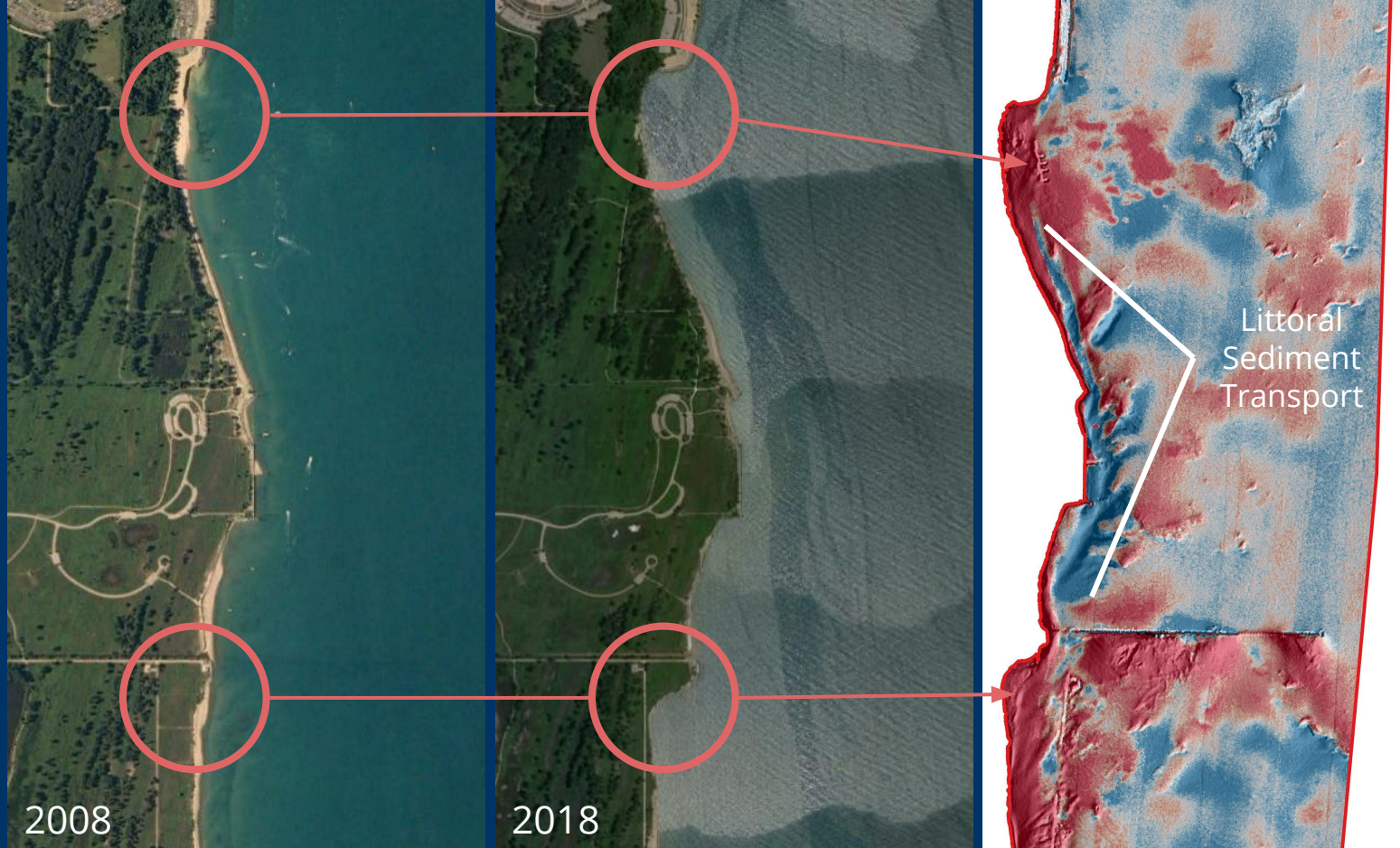
Coastal Erosion

Impact to coastal wetlands

Littoral sediment transport

Red - erosion

Blue - deposition



Economic and Social Impacts

- Damage to coastal infrastructure
- Flooded marinas and docks
- Hazards to navigation
- Shrinking beaches for recreational use
- Damage and loss of private property
- Solastalgia - distress caused by environmental change^{*}

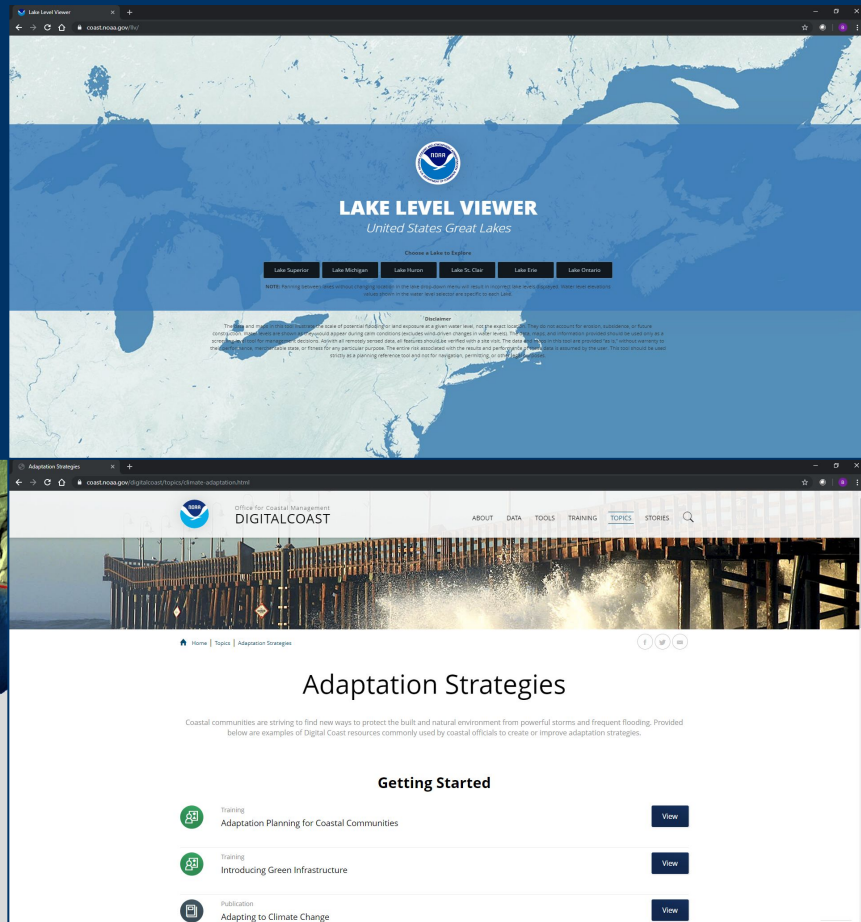
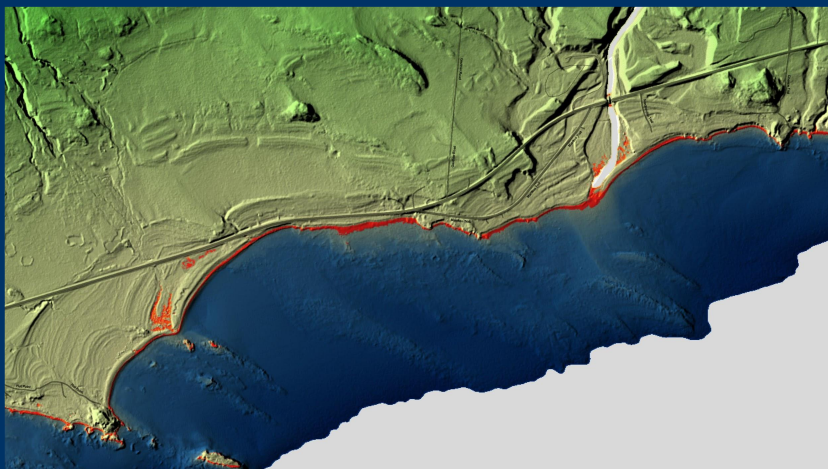


^{*}Albrecht, Glenn (2007). "Solastalgia: the distress caused by environmental change". *Australasian Psychiatry*. **15**: S95-S98. doi:10.1080/10398560701701288. PMID 18027145

Digital Coast

Data, Tools, Trainings, and Resources

<https://coast.noaa.gov/digitalcoast/>



Office for Coastal Management



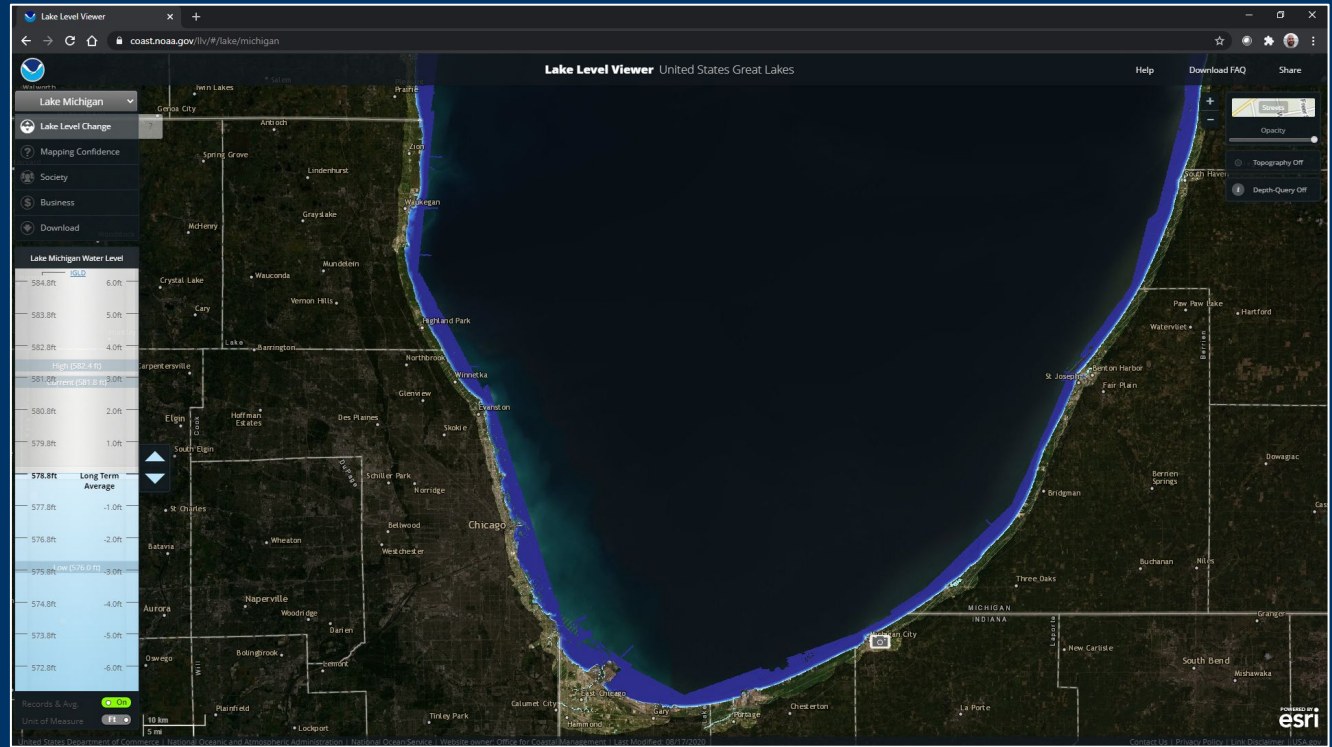
Data and Tools to Help Understand Impacts

NOAA's Lake Level Viewer

40% of Coastal Storms Program survey respondents said current data on future lake level changes are inadequate

Only 26% said existing tools to work with or visualize these data are adequate

Source: 2013 Shoreline Change Workshop: Perspectives on the Great Lakes Survey



Great Lakes Coastal Zone Management Programs





Thank You!

Brandon Krumwiede GCP-R, GISP
brandon.krumwiede@noaa.gov
(320) 290-1381
@bkgeospatial